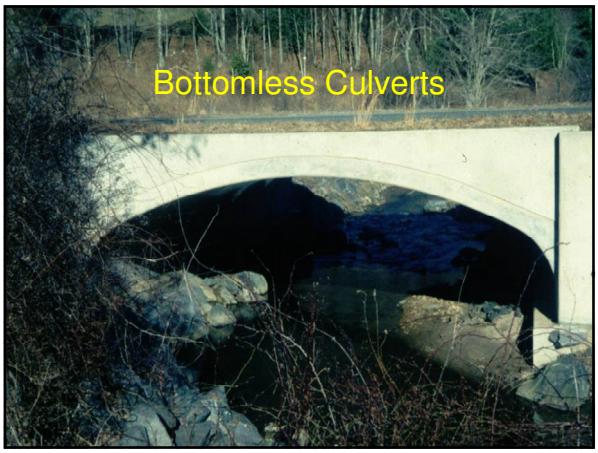


Bridge or Culvert ?

- Bridge: The structure generally consist of a deck or superstructure supported on two abutments and often includes intermediate piers.
- Culvert: A structure which is usually covered with embankment and is composed of structural material around the entire perimeter, although some are supported on spread footings with the channel bed serving as the bottom of the culvert.

- Culverts 20' or greater in width are included in Bridge Maintenance Inventory
- Function hydraulically like a bridge unless they are very long.

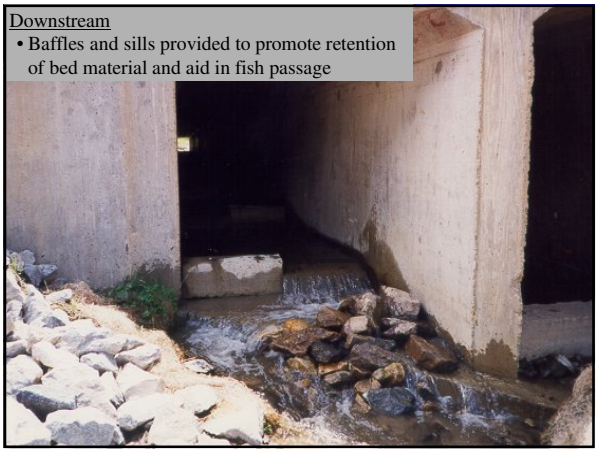
Bottomless Culvert

Ashe County
- Footings founded on non erosive rock
- Concrete headwall with stamped design

Conventional Box Culvert

Upstream End
- Low flow channel through one barrel
- invert buried below stream bed elevation

Downstream
- Baffles and sills provided to promote retention of bed material and aid in fish passage



Vertical Abutment Bridge

- An abutment, usually with wingwalls, that has no fill slope on its channel side.

Br #57 Franklin Co
Sycamore Creek
- Built 1966
- 40' single span
- Typical construction on older secondary road bridges
- Large numbers of this type structure were damaged during 1977 in Western NC as a result of abutment and contraction scour

Spillthrough Abutment Bridge

- A bridge abutment having a fill slope on the channel side.

- Current bridge design criteria calls for a minimum set back of ten feet from the stream top of bank to the toe of the spill through slope.
- Spill through slope is rip rapped to provide protection from abutment scour, and abutment scour occurs at toe of slope instead of at bridge end bent support

Shows spill through abutment and interior bents without superstructure

Design Criteria for Culverts

- Must safely provide conveyance of the design storm event
- Must be economical to construct and maintain (including future replacement cost)
- Should maintain low flow channel and promote retention of bed material
- Must have shallow non erosive rock present before considering bottomless culvert

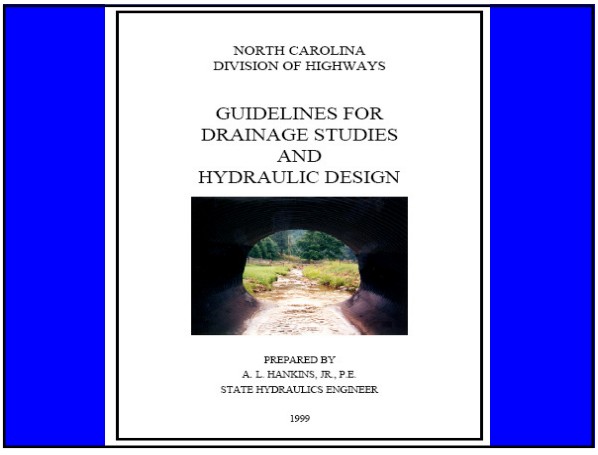
Must safely provide conveyance of the design storm event

- Secondary Roads 25 year
- Primary Routes 50 year
- Consideration for 100 year

Must be economical to construct and maintain (including future replacement cost)

- Minimum structure size that meets hydraulic requirements
- Non-standard headwall heights to reduce culvert length not allowed

- Minimum size verified by analysis of next smallest size during design process
- Use of Proprietary headwalls usually result in higher future maintenance cost due to availability



Length and Slope

The slope of a culvert should approximate that of the natural channel. The invert elevation should be slightly below the natural bed ranging from 0.1 +/- feet for small pipes to 1.0 +/- feet for large box culvert. Where fish passage is a primary consideration, the invert should be a minimum of 1.0 feet below the natural bed. Baffles may be placed in the invert to promote retention of bed material and formation of a low flow channel. **When a shallow (3-5 foot max. depth) non-erosive rock foundation is found throughout the proposed site, the structure can be built on footings without a bottom allowing retention of natural channel bed. The Geotechnical Unit must confirm the foundation acceptability prior to selection of the "bottomless" culvert.**

- Preliminary subsurface investigation during pre design site visit (rod sounding, probe) to rule out bottomless structures
- If preliminary investigation indicates bottomless culvert may be feasible then Geotechnical investigation is required to confirm non erosive rock
- Guidelines can be found on the Hydraulics Unit Webpage

Why Require Rock Foundation?

- Scour will not be an issue
- Differential settlement is not an issue
- Minimization of stream disturbance during construction

Why Not Construct Footings Far Enough From Stream Banks To Avoid Scour and Construction Impacts ?

- Structure would greatly exceed what is necessary to meet hydraulic conveyance requirements. (excessive initial cost)
- Future maintenance cost of oversized structure would not be considered good stewardship of tax payers dollars